

# SEXUAL DIMORPHISMS OF A RARE BOTHID FLOUNDER, *GRAMMATOBOTHUS PENNATUS* (BOTHIDAE, PLEURONECTIFORMES)

by

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**ABSTRACT.** - The sexual dimorphisms of a rare bothid flounder *Grammatobothus pennatus* are reported based on 25 specimens collected at New Caledonia, Chesterfield Islands and Northwestern Australia. In males, the ocular-side pectoral fin and the fourth dorsal-fin ray are longer than corresponding features in females, and two conspicuous cephalic blotches (one observed just anterior to and the other just anterodorsal to the upper eye) are evident in large males (versus faint or absent in females and smaller males). Differences between sexual dimorphisms observed in *G. pennatus* and *G. polyophthalmus* are discussed.

**RÉSUMÉ.** - Le dimorphisme sexuel d'une espèce rare de Bothidae, *Grammatobothus pennatus* (Pleuronectiformes : Bothidae).

Le dimorphisme sexuel de *Grammatobothus pennatus*, une espèce rare de Bothidae, a été étudié chez 25 spécimens provenant de Nouvelle-Calédonie, des îles Chesterfield et du nord-ouest de l'Australie. La nageoire pectorale du côté oculé et le quatrième rayon de la nageoire dorsale sont plus longs chez les mâles que chez les femelles et les mâles possèdent deux taches céphaliques à proximité immédiate de l'œil supérieur, antérieurement et antérodorsalement. Ce dimorphisme sexuel chez *G. pennatus* est comparé à celui qui est présent chez *G. polyophthalmus*.

**Key words.** - Bothidae - *Grammatobothus pennatus* - PSW - Sexual dimorphisms.

A rare bothid flounder, *Grammatobothus pennatus* (Ogilby, 1913) was originally described quite in detail but based only on a single specimen from off Queensland, Australia. Subsequently, Norman (1926) gave a short description of this species based on seven additional specimens collected from the same region. Since then, substantial knowledge concerning morphological data for *G. pennatus* has not been increased despite the fact that this species has sometimes been recorded elsewhere (Gloerfelt-Tarp and Kailola, 1984; Rivaton *et al.*, 1989; Kulbicki *et al.*, 1994). Accordingly, the morphological variation within this species has not been adequately addressed. From the waters of New Caledonia, Chesterfield Islands and adjacent waters, and Northwestern Australia (Fig. 1), 25 specimens of *G. pennatus* (Fig.2) were obtained, and detailed examination of these specimens revealed sexual dimorphisms newly recorded for this species. The sexual dimorphisms observed in *G. pennatus* are compared with those of *G. polyophthalmus* (Bleeker, 1865).

## MATERIAL AND METHODS

Methods of counts and measurements followed Hubbs and Lagler (1958), except that each dorsal- and anal-fin ray was counted individually. Museum codes follow Leviton *et*

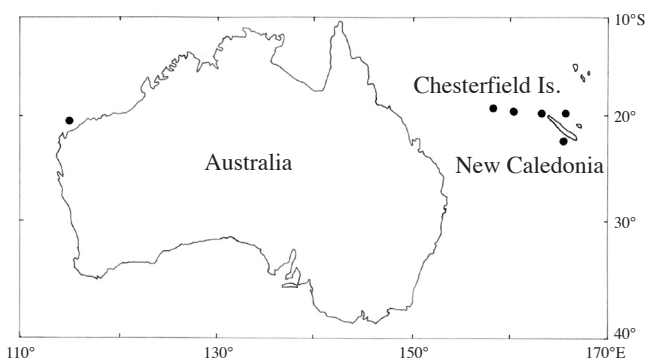


Figure 1. - Capture localities of *Grammatobothus pennatus*.

*al.* (1985). SL and HL are standard length and head length, respectively.

## Specimens examined

**New Caledonia.** - Males: HUMZ 170705 (136.2 mm SL), other data unknown; MNHN 1999-1917 (149.9 mm SL), 22°04.09'S, 166°05.20'E, 13 m, 20 Aug. 1985, otter trawl; MNHN 1999-1923 (1 of 3 specimens, 140.3 mm SL), 19°57.03'S, 163°52.08'E, 25-26 m, 24 Oct. 1989, beam trawl; MNHN 1999-1923 (2 of 3 specimens, 128.5 and 140.6 mm SL), 19°59.01'S, 163°52.08'E, 25-26 m, 24 Oct. 1989, beam trawl. Females: HUMZ 170706 (156.5 mm SL), other data unknown; HUMZ 170711 (158.1 mm SL), 22°04.09'S, 166°05.20'E, 13 m, 20 Aug. 1985, otter trawl;

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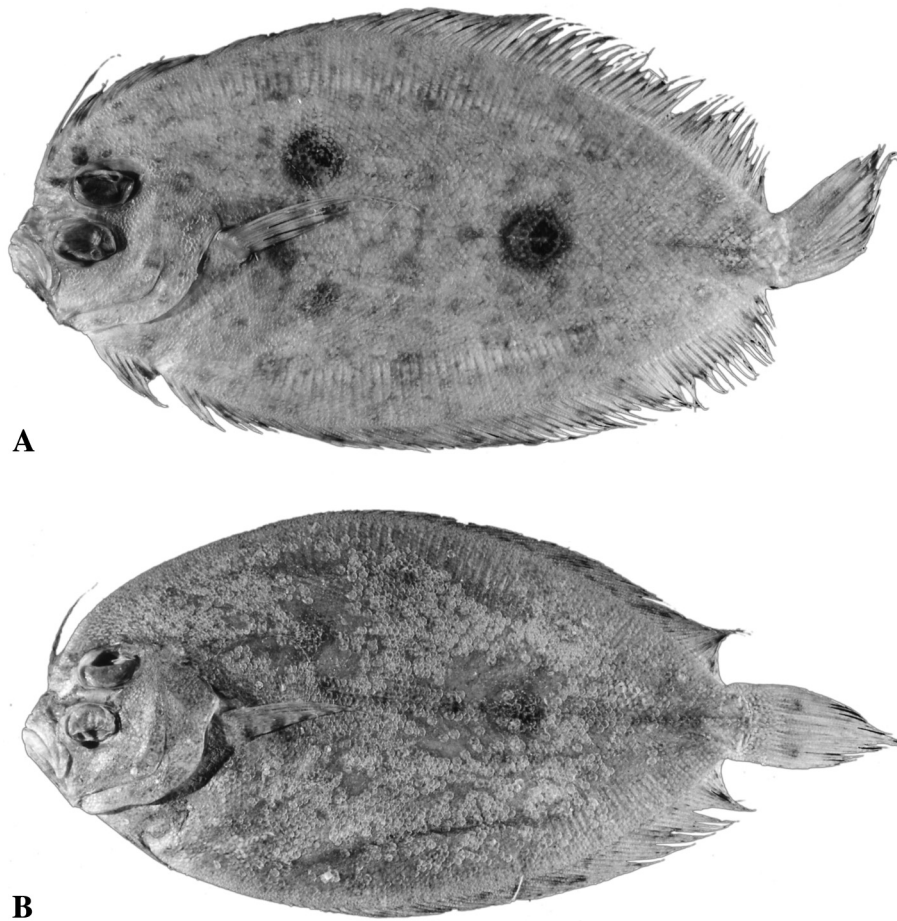


Figure 2. - *Grammatobothus pennatus*.  
**A:** Male, HUMZ 170707, 138.2 mm SL; **B:** Female, HUMZ 170711, 158.1 mm SL.

MNHN 1999-1917 (150.0 mm SL), 22°04.09'S, 166°05.20'E, 13 m, 20 Aug. 1985, otter trawl.

*Chesterfield Islands and adjacent waters.* - Males: HUMZ 170707 (138.2 mm SL), 20°21.29'S, 160°58.60'E, 75 m, Fairway Ridge, 22 Jul. 1988, beam trawl; HUMZ 170709 (128.0 mm SL), 19°22.87'S, 158°44.15'E, 74 m, Chesterfield Plateau, 28 Jul. 1988, beam trawl; HUMZ 170710 (116.1 mm SL), 20°40.08'S, 158°51.05'E, 78 m, Bellona Plateau, 21 Aug. 1988, beam trawl; MNHN 1999-1916 (119.2 mm SL), 20°39.06'S, 158°36.08'E, 78-80 m, Bellona Plateau, 22 Aug. 1988, trawl; MNHN 1999-1919 (99.1 and 126.3 mm SL), 20°35.30'S, 158°47.40'E, 67 m, Bellona Plateau, 23 Jul. 1984, beam trawl; MNHN 1999-1921 (118.4 mm SL), 20°30.83'S, 161°05.21'E, 80 m, Fairway Ridge, 15 Jul. 1984, beam trawl; MNHN 1999-1922 (126.2 mm SL), 19°17.90'S, 158°35.50'E, 65-68 m, Chesterfield Plateau, 18 Jul. 1984, beam trawl. Females: HUMZ 170708 (132.0 mm SL), 20°44.08'S, 158°40.08'E, 84 m, Bellona Plateau, 22 Aug. 1988, beam trawl; MNHN 1999-1918 (133.8 mm SL), 20°02.05'S, 163°52.06'E, 23 m, Bellona Plateau, 02 Jul. 1986, otter trawl; MNHN 1999-1919 (99.1 mm SL), 20°35.30'S, 158°47.40'E, 67 m, Bellona Plateau, 23 Jul. 1984, beam trawl; MNHN 1999-1920 (122.9 and 126.1 mm SL), 21°24.90'S, 159°09.30'E, 60 m, Bellona Plateau, 25 Jul. 1984, beam trawl; MNHN 1999-1922 (135.7 mm SL), 19°17.90'S, 158°35.50'E, 65-68 m, Chesterfield Plateau, 18 Jul. 1984, beam trawl.

*Northwestern Australia.* - Males: NSMT-P 60423 (131.0 mm SL) and 60424 (134.0 mm SL): 20°22'S, 115°50'E, 42-48 m, date unknown, R/V Tanshu-maru; NSMT-P 60405 (184.3 mm SL),

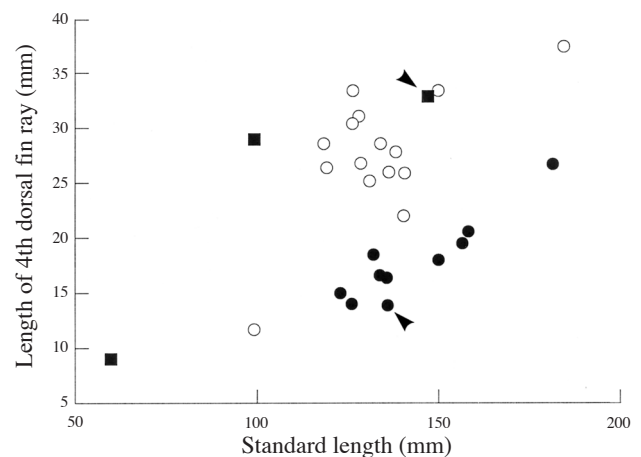


Figure 3. - Length of fourth dorsal-fin ray in two species of *Grammatobothus*. White circle: male *G. pennatus*; black circle: female *G. pennatus*; black square: female *G. krempfi*. Arrows indicate holotypes.

20°13'S, 115°58'E, 52 m, 10 May 1972, R/V Tanshu-maru. Female: NSMT-P 60422 (181.3 mm SL), collected with NSMT-P 60423 and 60424.

*Queensland.* - Female: QM I-1557 (136 mm SL), holotype of *Platophrys pennata*, examined from radiograph.

### Comparative material

*Grammatobothus krempfi* (all females): MNHN 1947-19 (holotype), 147.0 mm SL, Poulo Condore, Vietnam; MNHN 1999-1924, 59.7 mm SL, 20°27.35'S, 161°04.70'E, Fairway Ridge, 22 Jul. 1988; NTUM 05502, 99.2 mm SL, Tai-Nan, Taiwan, 22 Oct. 1978.

### DESCRIPTION OF SEXUAL DIMORPHISMS

Ocular-side pectoral fin elongated in males, 17.6-41.1% of SL in males vs. 15.9-19.7% in females; fourth dorsal-fin ray of males ( $\geq 116.1$  mm SL) longer than that of females, 15.7-26.4% of SL vs. 11.1-14.7% (Fig. 3); elliptical dark blotches just anterior to and just anterodorsal to upper eye conspicuous in large ( $\geq 128.5$  mm SL) males, whereas blurry or absent in females and small ( $\leq 126.5$  mm SL) males (Fig. 4).

### DISCUSSION

#### Identification

Counts and measurements are shown in table I. The present specimens belong to the bothid genus *Grammatobothus* because they have sinistral bilaterality, asymmetric pelvic fins with that on ocular side having a longer base, fused branchiostegal membranes, intermuscular bones (familial diagnoses: Norman, 1934; Amaoka, 1969), narrow but concave interorbital space similar in both sexes, and a lateral line developed on the blind side (generic diagnoses: Norman, 1926, 1934). Three species are known in this genus: *G. polyophthalmus*, *G. pennatus* and *G. krempfi* Chabanaud, 1929. The present specimens are identified as *G. pennatus*, and distinguished from *G. polyophthalmus* in their relatively shallow body (1.81-2.03 in SL, vs. 1.59-1.76 in *G. poly-*

*ophthalmus*), and from *G. krempfi* in their relatively short pelvic fin (2.01-2.45 in HL, vs. 1.54-1.82 in *G. krempfi*) and shorter fourth dorsal-fin ray in females (Norman, 1934; Amaoka *et al.*, 1992; present study).

### Sexual dimorphisms

In various species of the Bothidae, sexual dimorphisms appear in a variety of features such as a typically wider interorbital space, orbital and rostral spines, and elongated pectoral-fin in males (e.g., Norman, 1934; Amaoka, 1969). *Grammatobothus polyophthalmus* is reported to have sexually dimorphic features in the ocular-side pectoral-fin length, anterior dorsal-fin ray length, and cephalic blotches (Amaoka *et al.*, 1992). Although *G. pennatus* exhibits similar sexual

Table I. - Counts and measurements of holotype and 25 non-type specimens of *Grammatobothus pennatus*. \*os: ocular side; bs: blind side. \*\* SL and HL were examined by Mr. J. Johnson (QM); meristic characters were counted from radiograph.

	Non-types	**Holotype (QM I-1557)
Counts		
Dorsal fin rays	82-92	ca. 85
Anal fin rays	65-74	ca. 70
P1 fin rays (os)*	13-16	-
(bs)*	11-14	-
P2 fin rays (os)	6	-
(bs)	6	-
Caudal fin rays	17	-
Abdominal vertebrae	10	9
Caudal vertebrae	28-30	28
Lateral line scales	76-85	-
Upper gill rakers	0-5	-
Lower gill rakers	7-11	-
SL (mm)	99.1-184.3	136
in SL		
Head length (HL)	3.32-4.07	3.68
Body depth	1.81-2.03	-
in HL		
Snout length	3.82-4.64	-
Upper eye diameter	3.35-4.04	-
Lower eye diameter	3.32-4.04	-
Interorbital width	10.08-26.31	-
Upper jaw length (os)	2.65-3.05	-
(bs)	2.96-3.37	-
Lower jaw length (os)	2.10-2.41	-
(bs)	1.95-2.33	-
Depth of caudal peduncle	2.41-3.18	-
P1 length (os)	0.66-1.64	-
(male)	(0.66-1.46)	-
(female)	(1.38-1.64)	-
P1 length (bs)	2.40-2.94	-
P2 length (os)	2.01-2.45	-
(bs)	2.59-3.07	-
P2 base length (os)	3.87-4.84	-
(bs)	5.04-6.76	-

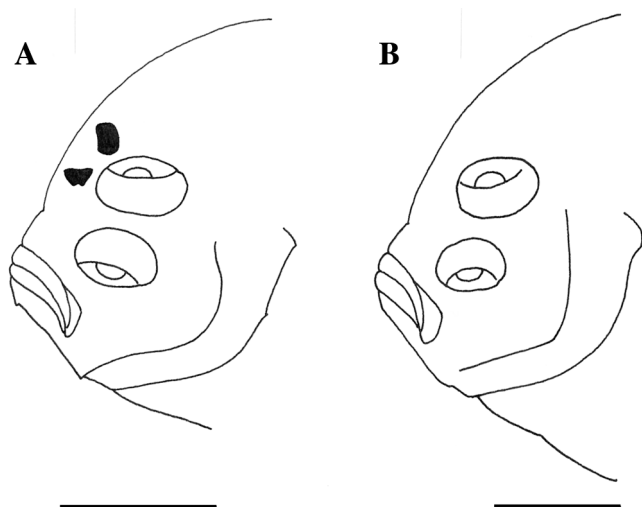


Figure 4. - Sexual dimorphism of cephalic blotches in *Grammatobothus pennatus*. A: Male; B: Female. Scale bars = 5 mm.

dimorphisms, their characteristics are different from those of *G. polyophthalmus*. In *G. pennatus*, pectoral-fin elongation in males is less remarkable (17.6-41.1% of SL vs. 21.5-52.0% in *G. polyophthalmus*); only the fourth dorsal-fin ray is apparently longer in males than in females (Fig. 3) (vs. second to tenth rays longer in males than in females in *G. polyophthalmus*); and two remarkable elliptical blotches located just anterior to and just anterodorsal to the upper eye (Fig. 4) (vs. chromosome-like blotches just anterodorsal to and above upper eye in male *G. polyophthalmus*) (Amaoka *et al.*, 1992; present study). Also, Amaoka *et al.* (1992) reported that, *G. polyophthalmus* had the membranes on the posterior surface of the prolonged dorsal-fin rays, which are more expanded in male. *G. pennatus* has similar membranes, but differences in their widths were not observed between males and females.

Sexual dimorphisms of *G. krempfi* are unknown, because all available specimens are females. However, in *G. krempfi*, length of the fourth dorsal-fin ray (15.1-29.2% of SL) is beyond that of female *G. pennatus* (11.1-14.7%), and overlaps with that of male *G. pennatus* (15.7-26.4%) (Fig. 3). This represents a new character that distinguishes females of *G. pennatus* and *G. krempfi*, in addition to the longer pelvic-fin length observed in *G. krempfi* (Norman, 1934; present study: see section 'Identification' above). Numbers of dorsal- and anal-fin rays, previously believed to distinguish these two species (Norman, 1934), are not diagnostic because these species have overlapping counts (dorsal-fin rays: 82-92 in *G. pennatus* vs. 82-87 in *G. krempfi*; anal-fin rays: 65-74 vs. 66-71) (present study).

### Distribution

*Grammatobothus pennatus* is known from Eastern Queensland (Ogilby, 1913; Norman, 1926), Northwestern Australia (Gloerfelt-Tarp and Kailola, 1984; present study), New Caledonia (Rivaton *et al.*, 1989; present study), and Chesterfield Islands and adjacent waters (Kulbicki *et al.*, 1994; present study).

**Acknowledgments.** - We are grateful to Mr. J. Rivaton (ORSTOM), Dr. M. Desoutter (MNH), Drs. S. Kawahara and K. Yokawa (FSFL), Drs. K. Matsuura and G. Shinohara (NSMT-P), and Drs. S.-C. Shen and T.-S. Chiu (NTUM) for loaning specimens. Mr. J. Johnson (QM) kindly examined the holotype of *Platophrys pen-*

*nata* and sent its radiograph to us. We express sincere thanks to Dr. B. Chanet (IUEM-UBO) for his translation of our English abstract into French résumé. Hoshino K. received financial support from the Postdoctoral Fellowship Program of the Smithsonian Institution.

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Reçu le 13 janvier 2003.

Accepté pour publication le 30 janvier 2004.